



TFT LCD Approval Specification

MODEL NO.: N170C1 - L02

Customer : Fujitsu

Approved by : _____

Note :

Liquid Crystal Display Division	
QRA Division.	OA Head Division.
Approval	Approval
	

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**REVISION HISTORY**

Version	Date	Page (New)	Section	Description
Ver 1.1	June 24,2005	All	All	Preliminary Specification V1.1 was first issued
Ver 3.0	July 14,2005	P5	2.2	Change the BL Max lamp current from 7.0 mA to 6.5mA
		P8	3.2	Change life time current from 6.0mA to 6.5mA
				Change BL Power consumption from 9.42W to 9.12W
		P12	5.1	"Connector part no" delete "Equivalent"
		P20	6.2	T7 (0<=T7<=10ms) change to T7(0<=T7<=50ms)
		P21	7.2	Change the "definition of Average Luminance of White (L _{AVE})" from "5 points" to "Center point"
				Change the contrast typical value from 600 to 550; min value from 450 to 400
Ver 3.1	Aug 09,2005	P21		Rx change from 0.644 to 0.643
				Ry change from 0.348 to 0.349
				Gx change from 0.285 to 0.283
				By change from 0.072 to 0.074
				Change the contrast typ from 550 to 600
Ver 3.2	Aug 22,2005	P21		Change the contrast min from 400 to 450
		P23		Add Optical spec of "White Variation of A and B": Min 70%
				Note 6: Change the luminance measure way of "White Variation of A and B" from 5 points to "Any points".

1. GENERAL DESCRIPTION

1.1 OVERVIEW

N170C1 - L02 is a 17.0" TFT Liquid Crystal Display module with two CCFLs Backlight unit and 30 pins LVDS interface. This module supports 1440 x 900 Wide-XGA mode and can display 262,144 colors. The optimum viewing angle is at 6 o'clock direction. The inverter module for Backlight is not built in.

1.2 FEATURES

- Thin and High Brightness
- WXGA (1440 x 900 pixels) resolution
- DE only mode
- 3.3V LVDS (Low Voltage Differential Signaling) interface with 2 pixel/clock
- 2 CCFLs

1.3 APPLICATION

- TFT LCD Notebook

1.4 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Active Area	367.2 (H) x 229.5 (V) (17.0" diagonal)	mm	(1)
Bezel Opening Area	371.2 (H) x 233.5 (V)	mm	
Driver Element	a-si TFT active matrix	-	-
Pixel Number	1440 x R.G.B. x 900	pixel	-
Pixel Pitch	0.255 (H) x 0.255 (V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	262,144	color	-
Transmissive Mode	Normally white	-	-
Surface Treatment	Hard coating (2H), Glare Type	-	-

1.5 MECHANICAL SPECIFICATIONS

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	381.7	382.2	382.7	mm	(1)
	Vertical (V)	246.3	246.8	247.3	mm	
	Depth (D)	---	9.7~8.3	10.0~8.6	mm	
Weight		---	950	980	g	-

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.

2. ABSOLUTE MAXIMUM RATINGS

2.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	T _{ST}	-20	+60	°C	(1)
Storage Humidity	H _{ST}	5	90		(1)
Operating Ambient Temperature	T _{OP}	0	+50	°C	(1), (2)
Operating Humidity	H _{OP}	20	90		(1)
Shock (Non-Operating)	H _{ST}	-	200	G	(3), (5)
Vibration (Non-Operating)	V _{NOP}	-	1.5	G	(4), (5)

Note (1) Temperature and relative humidity range is shown below.

(a) 90 %RH Max. (Ta ≤ 40 °C).

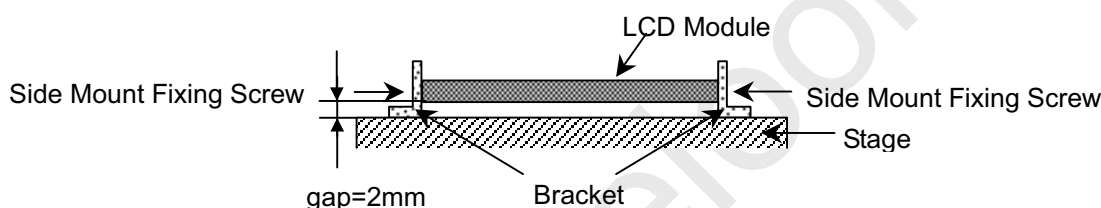
(b) Wet-bulb temperature should be 39 °C Max. (Ta > 40 °C).

(c) No condensation.

Note (2) The ambient temperature means the temperature of panel surface.

Note (3) 2ms, half sine wave, 1 times for ± X, ± Y, ± Z.

Note (4) 10 ~ 500 Hz, 30 min/cycle, 1 cycles for each X, Y, Z axis. The fixing condition is shown as below:



Note (5) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.

2.2 ELECTRICAL ABSOLUTE RATINGS

2.2.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	V _{CC}	-0.3	+4.0	V	(1)
Logic Input Voltage	V _{IN}	-0.3	V _{CC} +0.3	V	

2.2.2 BACKLIGHT UNIT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Lamp Voltage	V _L	—	2.5K	V _{RMS}	(1), (2), I _L = 6.0 mA
Lamp Current	I _L	—	6.5	mA _{RMS}	(1), (2)
Lamp Frequency	F _L	—	80	KHz	

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) Specified values are for lamp (Refer to 3.2 for further information).

3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD MODULE

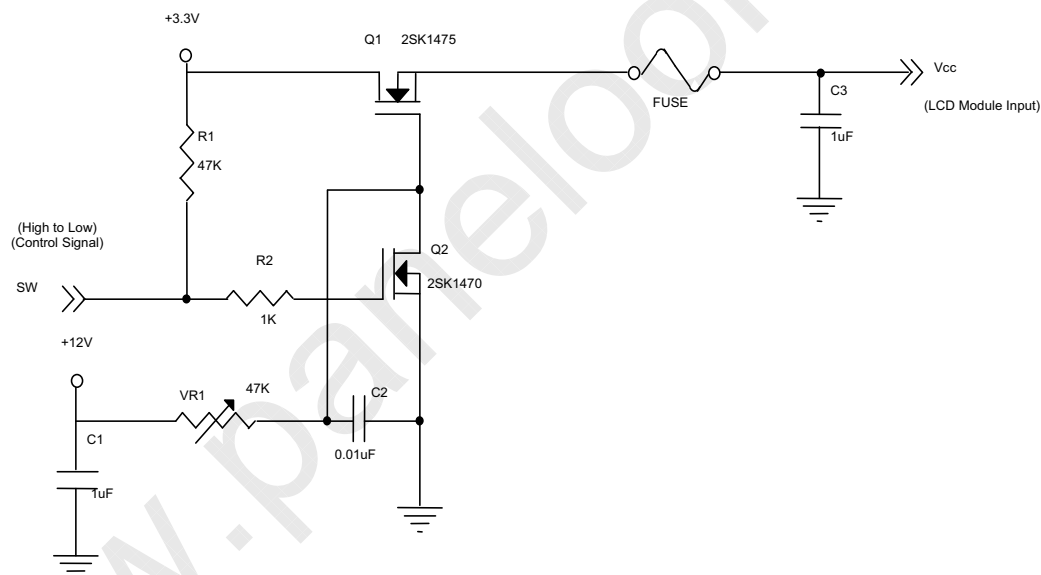
 $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V_{CC}	3.0	3.3	3.6	V	-
Ripple Voltage		V_{RP}		50		mV	-
Rush Current		I_{RUSH}		0.5		A	(2)
Power Supply Current	White	L_{CC}		450	480	mA	(3)a
	Black			570	600	mA	(3)b
Logical Input Voltage	"H" Level	V_{IL}			+100	mV	-
	"L" Level	V_{IH}	-100			mV	-
Terminating Resistor		R_T		100		Ohm	

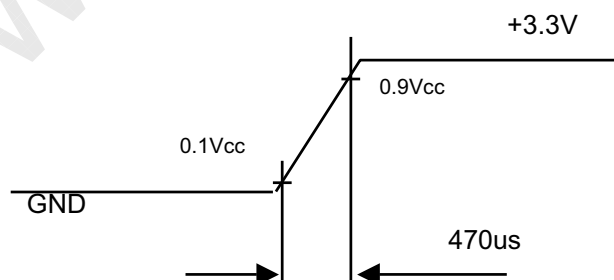
Note (1) The module should be always operated within above ranges.

Note (2) Measurement Conditions:

:



Vcc rising time is 470us



Note (3) The specified power supply current is under the conditions at $V_{CC} = 3.3\text{ V}$, $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$, $f_v = 60$

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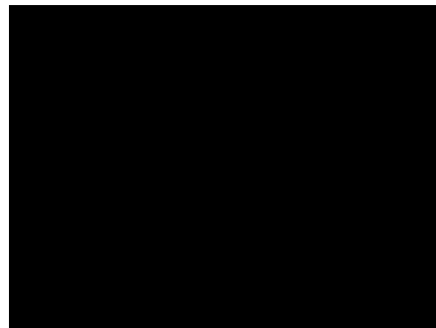
Hz, whereas a power dissipation check pattern below is displayed.

a. White Pattern



Active Area

b. Black Pattern



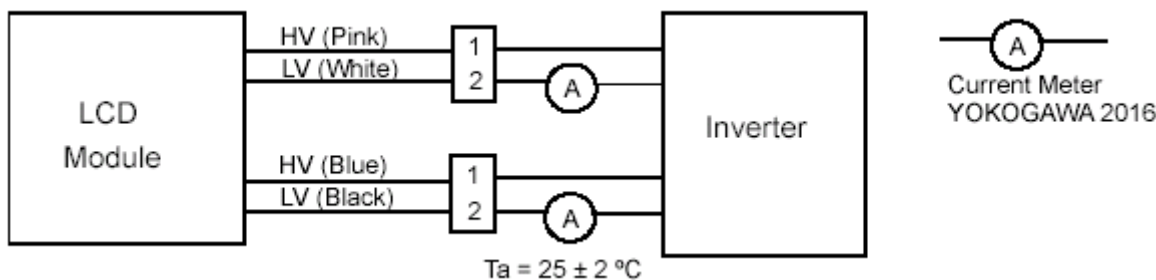
Active Area

3.2 BACKLIGHT UNIT

 $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Lamp Input Voltage	V_L	680	760	840	V_{RMS}	$I_L = 6.0\text{ mA}$
Lamp Current	I_L	2.0	6.0	6.5	mA_{RMS}	(1)
Lamp Turn On Voltage	V_S	—	—	1620 (25 $^{\circ}\text{C}$)	V_{RMS}	(2)
		—	—	1900 (0 $^{\circ}\text{C}$)	V_{RMS}	(2)
Operating Frequency	F_L	50	—	80	KHz	(3)
Lamp Life Time	L_{BL}	12,000	—	—	Hrs	(5)
Power Consumption	P_L	—	9.12	—	W	(4), $I_L = 6.0\text{ mA}$

Note (1) Lamp current is measured by utilizing a high frequency current meter as shown below:



Note (2) The voltage shown above should be applied to the lamp for more than 1 second after startup.

Otherwise the lamp may not be turned on.

Note (3) The lamp frequency may produce interference with horizontal synchronous frequency from the display, and this may cause line flow on the display. In order to avoid interference, the lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible.

Note (4) $P_L = I_L \times V_L \times 2$

Note (5) The lifetime of lamp can be defined as the time in which it continues to operate under the condition $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$ and $I_L = 6.5\text{ mA}_{RMS}$ until one of the following events occurs:

- When the brightness becomes or lower than 50% of its original value.
- When the effective ignition length becomes or lower than 80% of its original value. (Effective ignition length is defined as an area that has less than 70% brightness compared to the brightness in the center point.)

Note (6) The waveform of the voltage output of inverter must be area-symmetric and the design of the inverter must have specifications for the modularized lamp. The performance of the Backlight, such as lifetime or brightness, is greatly influenced by the characteristics of the DC-AC inverter for the lamp. All the parameters of an inverter should be carefully designed to avoid generating too much current leakage from high voltage output of the inverter. When designing or ordering the inverter please make sure that a poor lighting caused by the mismatch of the Backlight and the inverter (miss-lighting, flicker, etc.) never occurs. If the above situation is confirmed, the module should be operated in the same manners when it is installed in your instrument.

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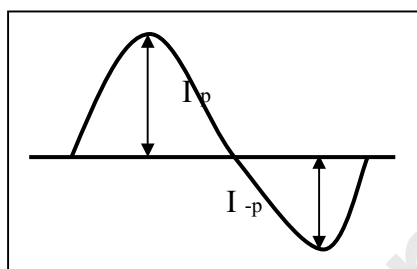
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The output of the inverter must have symmetrical (negative and positive) voltage waveform and symmetrical current waveform. (Unsymmetrical ratio is less than 10%) Please do not use the inverter, which has unsymmetrical voltage and unsymmetrical current and spike wave. Lamp frequency may produce interface with horizontal synchronous frequency and as a result this may cause beat on the display. Therefore lamp frequency shall be as away possible from the horizontal synchronous frequency and from its harmonics in order to prevent interference.

Requirements for a system inverter design, which is intended to have a better display performance, a better power efficiency and a more reliable lamp. It shall help increase the lamp lifetime and reduce its leakage current.

- The asymmetry rate of the inverter waveform should be 10% below;
- The distortion rate of the waveform should be within $\sqrt{2} \pm 10\%$;
- The ideal sine wave form shall be symmetric in positive and negative polarities.



* Asymmetry rate:

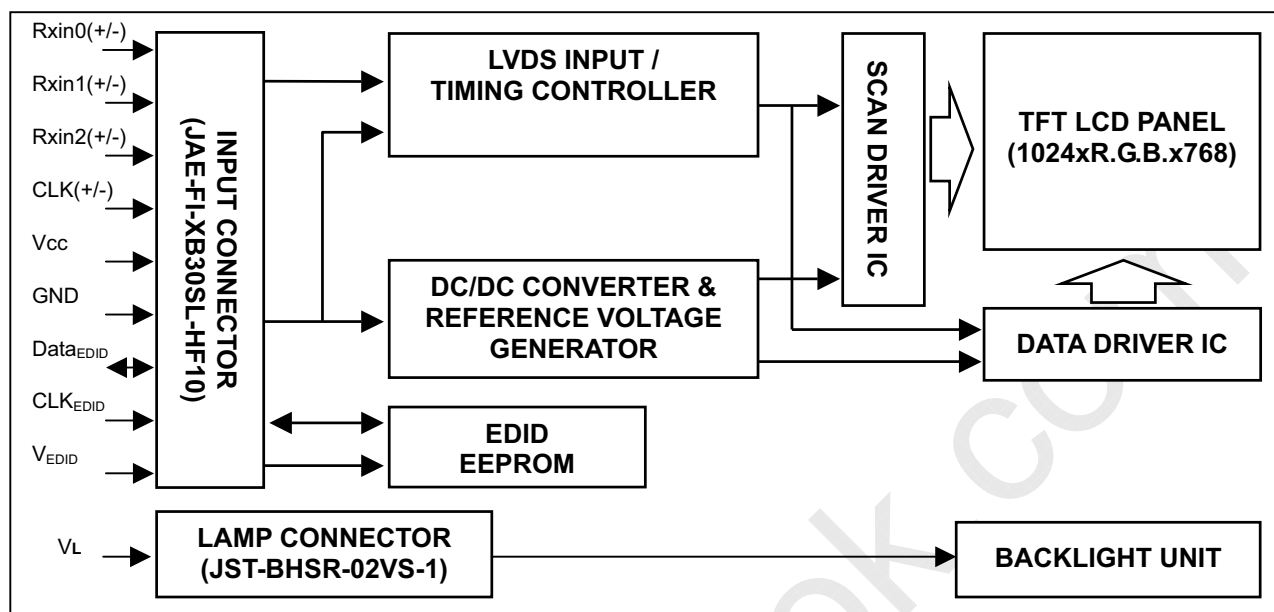
$$|I_p - I_{-p}| / I_{rms} * 100\%$$

* Distortion rate

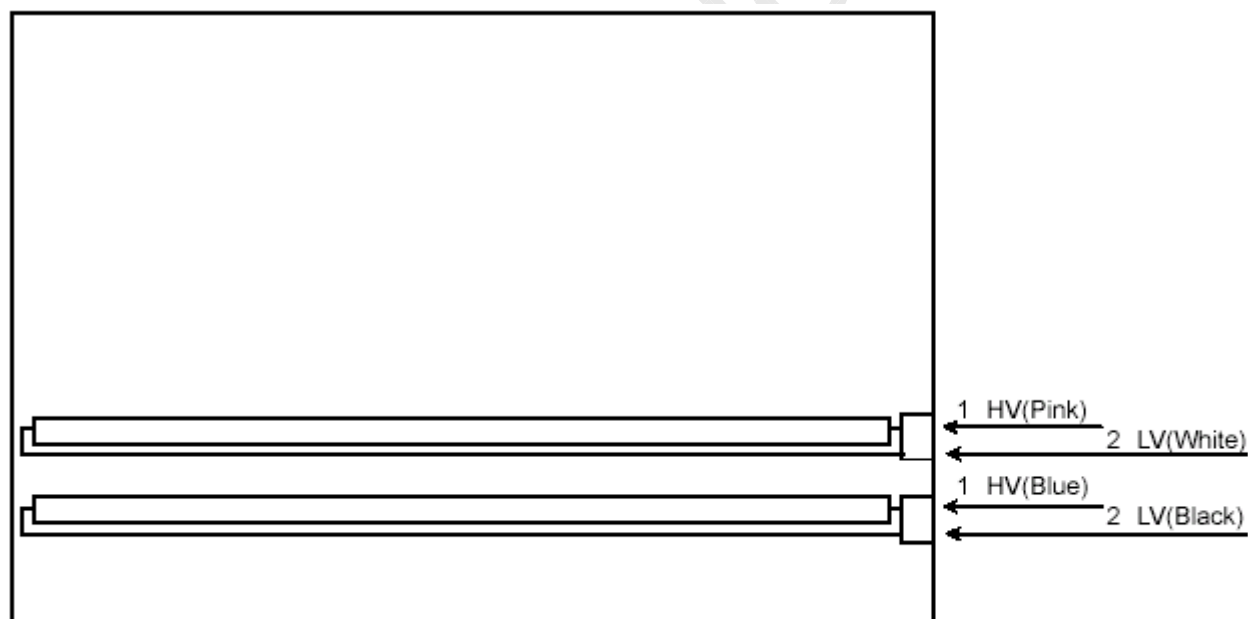
$$I_p \text{ (or } I_{-p}) / I_{rms}$$

4. BLOCK DIAGRAM

4.1 TFT LCD MODULE



4.2 BACKLIGHT UNIT



5. INPUT TERMINAL PIN ASSIGNMENT

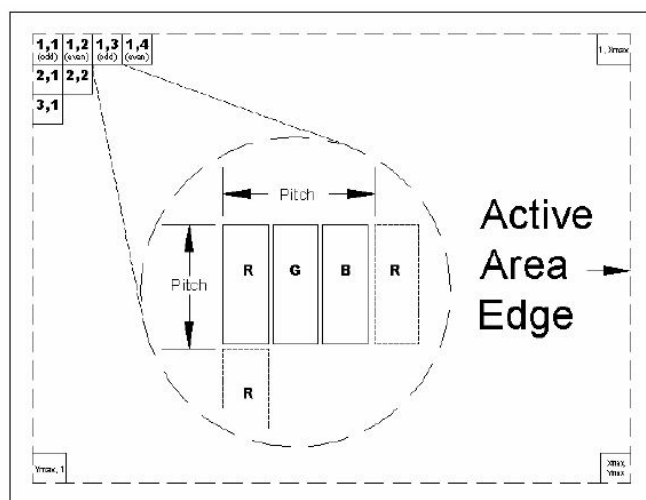
5.1 TFT LCD MODULE

Pin	Symbol	Description	Polarity	Remark
1	Vss	Ground		
2	Vcc	Power Supply +3.3 V (typical)		
3	Vcc	Power Supply +3.3 V (typical)		
4	V _{EDID}	DDC 3.3V Power		
5	NC	Non-Connection		
6	CLK _{EDID}	DDC Clock		
7	DATA _{EDID}	DDC Data		
8	RXO0-	LVDS Differential Data Input (Odd)	Negative	
9	RXO0+	LVDS Differential Data Input (Odd)	Positive	
10	Vss	Ground		
11	RXO1-	LVDS Differential Data Input (Odd)	Negative	
12	RXO1+	LVDS Differential Data Input (Odd)	Positive	
13	Vss	Ground		
14	RXO2-	LVDS Differential Data Input (Odd)	Negative	
15	RXO2+	LVDS Differential Data Input (Odd)	Positive	
16	Vss	Ground		
17	RXOC-	LVDS Clock Data Input (Odd)	Negative	
18	RXOC+	LVDS Clock Data Input (Odd)	Positive	
19	Vss	Ground		
20	RxE0-	LVDS Differential Data Input (Even)	Negative	
21	RxE0+	LVDS Differential Data Input (Even)	Positive	
22	Vss	Ground		
23	RxE1-	LVDS Differential Data Input (Even)	Negative	
24	RxE1+	LVDS Differential Data Input (Even)	Positive	
25	Vss	Ground		
26	RxE2-	LVDS Differential Data Input (Even)	Negative	
27	RxE2+	LVDS Differential Data Input (Even)	Positive	
28	Vss	Ground		
29	RXEC-	LVDS Clock Data Input (Even)	Negative	
30	RXEC+	LVDS Clock Data Input (Even)	Positive	

Note (1) Connector Part No.: JAE-FI-XB30SL-HF10

Note (2) User's connector Part No: JAE-FI-X30C2L

Note (3) The first pixel is odd as shown in the following figure.



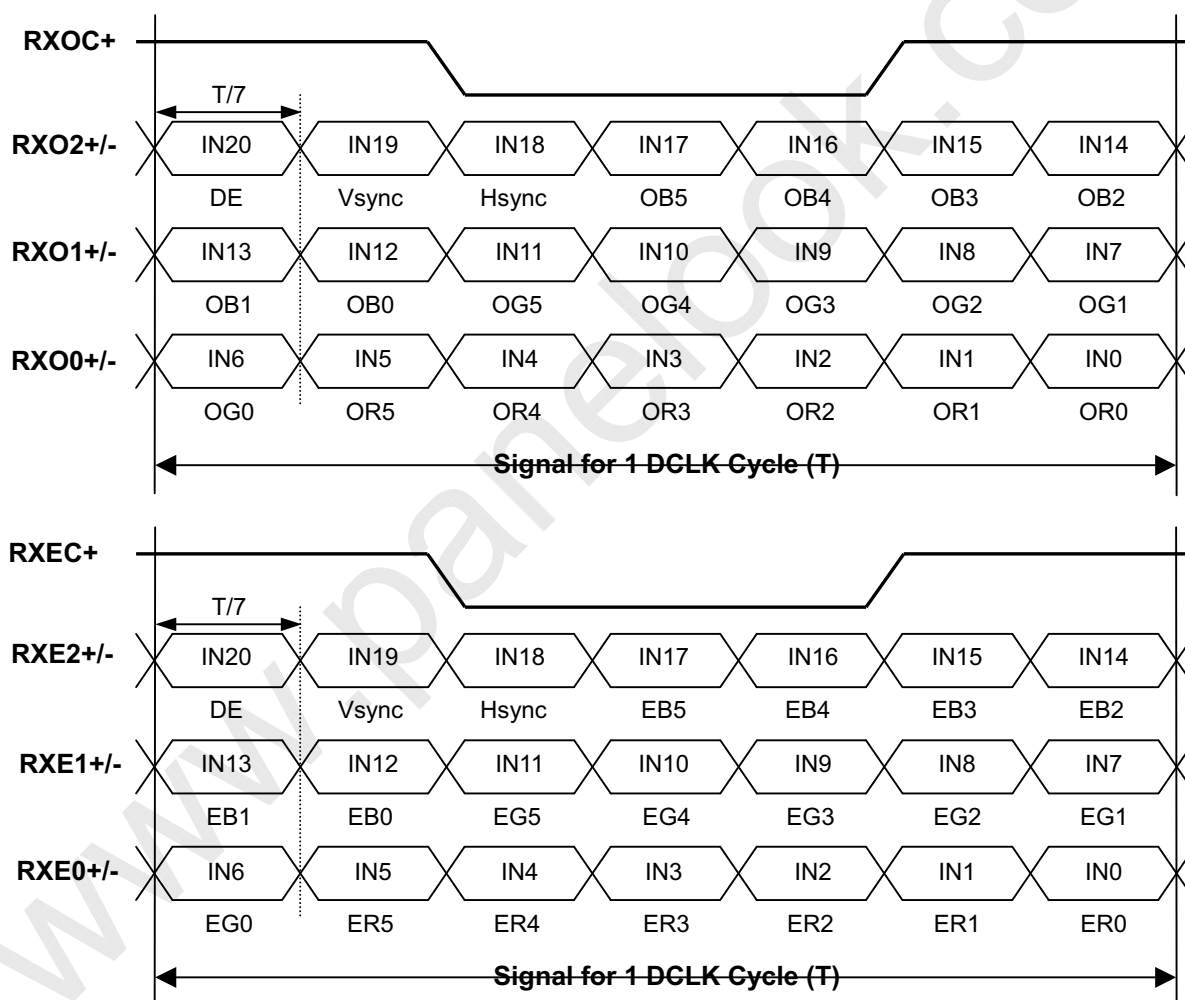
5.2 BACKLIGHT UNIT

Pin	Symbol	Description	Color
1	HV	High Voltage	Pink
2	LV	Ground	White
1	HV	High Voltage	Blue
2	LV	Ground	Black

Note (1) Connector Part No.: JST-BHSR-02VS-1

Note (2) User's connector Part No.: JST-SM02B-BHSS-1-TB

5.3 TIMING DIAGRAM OF LVDS INPUT SIGNAL



5.4 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 6-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of color versus data input.

Color		Data Signal																	
		Red						Green						Blue					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale Of Red	Red(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(1)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
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	Red(61)	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Red(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
Gray Scale Of Green	Green(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(1)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
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	Green(61)	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
	Green(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
Green(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	
Gray Scale Of Blue	Blue(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
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	Blue(61)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	Blue(62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
Blue(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	

Note (1) 0: Low Level Voltage, 1: High Level Voltage

5.5 EDID DATA STRUCTURE

The EDID (Extended Display Identification Data) data formats are to support displays as defined in the VESA Plug & Display and FPD1 standards.

Byte # (decimal)	Byte # (hex)	Field Name and Comments	Value (hex)	Value (binary)
0	0	Header	00	00000000
1	1	Header	FF	11111111
2	2	Header	FF	11111111
3	3	Header	FF	11111111
4	4	Header	FF	11111111
5	5	Header	FF	11111111
6	6	Header	FF	11111111
7	7	Header	00	00000000
8	8	EISA ID manufacturer name ("CMO")	0D	00001101
9	9	EISA ID manufacturer name (Compressed ASCII)	AF	10101111
10	0A	ID product code (N170C1-L02)	01	00000001
11	0B	ID product code (hex LSB first; N170C1-L02)	17	00010111
12	0C	ID S/N (fixed "0")	00	00000000
13	0D	ID S/N (fixed "0")	00	00000000
14	0E	ID S/N (fixed "0")	00	00000000
15	0F	ID S/N (fixed "0")	00	00000000
16	10	Week of manufacture (fixed "00H")	00	00000000
17	11	Year of manufacture (fixed "00H")	00	00000000
18	12	EDID structure version # ("1")	01	00000001
19	13	EDID revision # ("3")	03	00000011
20	14	Video I/P definition ("digital")	80	10000000
21	15	Max H image size ("37cm")	25	00100101
22	16	Max V image size ("23cm")	17	00010111
23	17	Display Gamma (Gamma = "2.2")	78	01111000
24	18	Feature support ("Active off, RGB Color")	0A	00001010
25	19	Red/Green (Rx1, Rx0, Ry1, Ry0, Gx1, Gx0, Gy1, Gy0)	FA	11111010
26	1A	Blue/White (Bx1, Bx0, By1, By0, Wx1, Wx0, Wy1, Wy0)	1D	00011101
27	1B	Red-x (Rx = "0.648")	A5	10100101
28	1C	Red-y (Ry = "0.347")	58	01011000
29	1D	Green-x (Gx = "0.283")	48	01001000
30	1E	Green-y (Gy = "0.611")	9C	10011100
31	1F	Blue-x (Bx = "0.141")	24	00100100
32	20	Blue-y (By = "0.071")	12	00010010
33	21	White-x (Wx = "0.319")	51	01010001
34	22	White-y (Wy = "0.333")	55	01010101
35	23	Established timings 1	00	00000000
36	24	Established timings 2	00	00000000
37	25	Manufacturer's reserved timings	00	00000000
38	26	Standard timing ID # 1	01	00000001
39	27	Standard timing ID # 1	01	00000001
40	28	Standard timing ID # 2	01	00000001
41	29	Standard timing ID # 2	01	00000001


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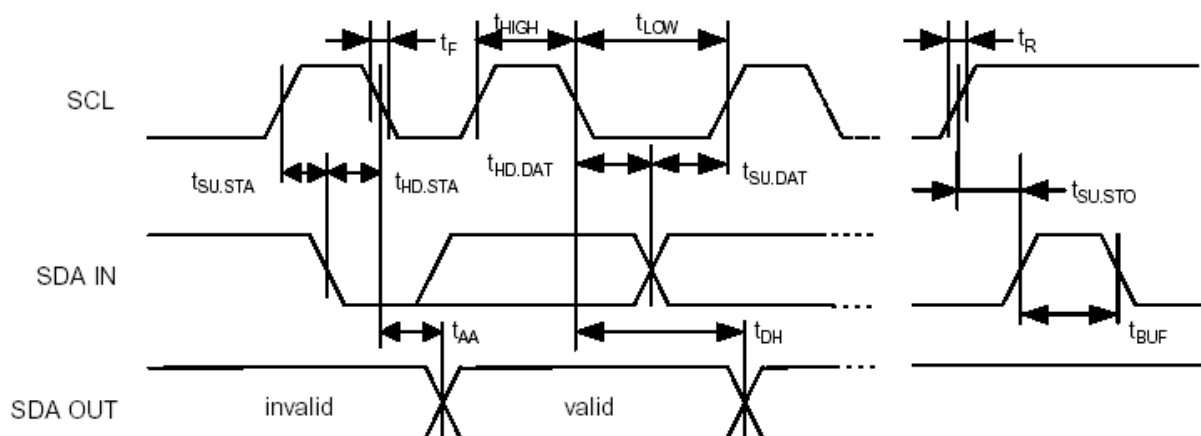
Byte # (decimal)	Byte # (hex)	Field Name and Comments	Value (hex)	Value (binary)
42	2A	Standard timing ID # 3	01	00000001
43	2B	Standard timing ID # 3	01	00000001
44	2C	Standard timing ID # 4	01	00000001
45	2D	Standard timing ID # 4	01	00000001
46	2E	Standard timing ID # 5	01	00000001
47	2F	Standard timing ID # 5	01	00000001
48	30	Standard timing ID # 6	01	00000001
49	31	Standard timing ID # 6	01	00000001
50	32	Standard timing ID # 7	01	00000001
51	33	Standard timing ID # 7	01	00000001
52	34	Standard timing ID # 8	01	00000001
53	35	Standard timing ID # 8	01	00000001
54	36	Detailed timing description # 1 Pixel clock ("96.21MHz")	95	10010101
55	37	# 1 Pixel clock (hex LSB first)	25	00100101
56	38	# 1 H active ("1440")	A0	10100000
57	39	# 1 H blank ("320")	40	01000000
58	3A	# 1 H active : H blank ("1440 : 320")	51	01010001
59	3B	# 1 V active ("900")	84	10000100
60	3C	# 1 V blank ("12")	0C	00001100
61	3D	# 1 V active : V blank ("900 : 12")	30	00110000
62	3E	# 1 H sync offset ("64")	40	01000000
63	3F	# 1 H sync pulse width ("32")	20	00100000
64	40	# 1 V sync offset : V sync pulse width ("3 : 3")	33	00110011
65	41	# 1 H sync offset : H sync pulse width : V sync offset : V sync width ("64: 32 : 3 : 3")	00	00000000
66	42	# 1 H image size ("367.2 mm")	6F	01101111
67	43	# 1 V image size ("229.5 mm")	E6	11100110
68	44	# 1 H image size : V image size ("367.2 : 229.5")	10	00010000
69	45	# 1 H boarder ("0")	00	00000000
70	46	# 1 V boarder ("0")	00	00000000
71	47	# 1 Non-interlaced, Normal, no stereo, Separate sync, H/V pol Negatives	18	00011000
72	48	Detailed timing description # 2	00	00000000
73	49	# 2 Flag	00	00000000
74	4A	# 2 Reserved	00	00000000
75	4B	# 2 FE (hex) defines ASCII string (Model Name "N170C1-L02", ASCII)	FE	11111110
76	4C	# 2 Flag	00	00000000
77	4D	# 2 1st character of name ("N")	4E	01001110
78	4E	# 2 2nd character of name ("1")	31	00110001
79	4F	# 2 3rd character of name ("7")	37	00110111
80	50	# 2 4th character of name ("0")	30	00110000
81	51	# 2 5th character of name ("C")	43	01000011
82	52	# 2 6th character of name ("1")	31	00110001
83	53	# 2 7th character of name ("-")	2D	00101101
84	54	# 2 8th character of name ("L")	4C	01001100
85	55	# 2 9th character of name ("0")	30	00110000

Byte # (decimal)	Byte # (hex)	Field Name and Comments	Value (hex)	Value (binary)
86	56	# 2 9th character of name ("2")	32	00110010
87	57	# 2 New line character indicates end of ASCII string	0A	00001010
88	58	# 2 Padding with "Blank" character	20	00100000
89	59	# 2 Padding with "Blank" character	20	00100000
90	5A	Detailed timing description # 3	00	00000000
91	5B	# 3 Flag	00	00000000
92	5C	# 3 Reserved	00	00000000
93	5D	# 3 FE (hex) defines ASCII string (Vendor "CMO", ASCII)	FE	11111110
94	5E	# 3 Flag	00	00000000
95	5F	# 3 1st character of string ("C")	43	01000011
96	60	# 3 2nd character of string ("M")	4D	01001101
97	61	# 3 3rd character of string ("O")	4F	01001111
98	62	# 3 New line character indicates end of ASCII string	0A	00001010
99	63	# 3 Padding with "Blank" character	20	00100000
100	64	# 3 Padding with "Blank" character	20	00100000
101	65	# 3 Padding with "Blank" character	20	00100000
102	66	# 3 Padding with "Blank" character	20	00100000
103	67	# 3 Padding with "Blank" character	20	00100000
104	68	# 3 Padding with "Blank" character	20	00100000
105	69	# 3 Padding with "Blank" character	20	00100000
106	6A	# 3 Padding with "Blank" character	20	00100000
107	6B	# 3 Padding with "Blank" character	20	00100000
108	6C	Detailed timing description # 4	00	00000000
109	6D	# 4 Flag	00	00000000
110	6E	# 4 Reserved	00	00000000
111	6F	# 4 FE (hex) defines ASCII string (Model Name"N170C1-L02", ASCII)	FE	11111110
112	70	# 4 Flag	00	00000000
113	71	# 4 1st character of name ("N")	4E	01001110
114	72	# 4 2nd character of name ("1")	31	00110001
115	73	# 4 3rd character of name ("7")	37	00110111
116	74	# 4 4th character of name ("0")	30	00110000
117	75	# 4 5th character of name ("C")	43	01000011
118	76	# 4 6th character of name ("1")	31	00110001
119	77	# 4 7th character of name ("-")	2D	00101101
120	78	# 4 8th character of name ("L")	4C	01001100
121	79	# 4 9th character of name ("0")	30	00110000
122	7A	# 4 9th character of name ("2")	32	00110010
123	7B	# 4 New line character indicates end of ASCII string	0A	00001010
124	7C	# 4 Padding with "Blank" character	20	00100000
125	7D	# 4 Padding with "Blank" character	20	00100000
126	7E	Extension flag	00	00000000
127	7F	Checksum	50	01010000

5.6 EDID SIGNAL SPECIFICATION

(1) EDID Power

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Absolute Maximum Ratings	Vcc		0	—	7.0	V
Recommended Operating Conditions	Vcc	Read Operation	2.7	—	5.5	V



(2) DC characteristics

		Symbol	Min.	Max.	Unit	Index
SCL, SDA terminal input voltage	High Voltage	VIH	0.7×Vcc	—	V	
	Low Voltage	VIL	—	0.3×Vcc	V	
Hysteresis Voltage		VHYS	0.05 VCC	—	V	
Output Voltage		VOL1 VOL2	—	0.4 0.6	V	IOL=3mA, CC=2.5V IOL=6mA, CC=2.5V
Input Leak current (Vin =0.1V~VCC)		ILI	-10 -10	10 50	uA	WP=VSS WP=VCC
Output Leak current		ILO	-10	10	uA	Vout =0.1V~VCC, WP=VSS
Terminal capacity(Input, Output)		Cin, Cout	—	10	pF	VCC=5.0V Ta=25°C, Fclk=1.0MHz
Operating current		ICC Write ICC Read	—	3 1	mA	VCC=5.5V, SCL=400KHz
Stillness current (SDA=SCL=VCC) (WP=VSS,A0,A1,A2=VSS)		ICCS	—	30 100	uA	VCC=3.0V VCC=5.5V



(3) AC characteristics (VCC=2.5~5.5V standard operation mode)

Item	Symbol	VCC=2.5V-5.5V (Standard operation mode)		VCC=4.5V-5.5V (High-speed operation mode)		Unit Index	
		Min.	Max.	Min.	Max.		
Clock frequency	Fclk	—	100	—	400	KHz	
Clock High Time	THIGH	4000	—	900	—	ns	
Clock Low Time	TLOW	4700	—	1300	—	ns	
SDA, SCL falling time	TR	—	1000	—	300	ns	
SDA, SCL rising time	TF	—	300	—	300	ns	
START hold time	THD: STA	4000	—	600	—	ns	
START setup time	TSU: STA	4700	—	600	—	ns	
Data input hold time	THD: Data	0	—	0	—	ns	
Data input setup time	TSU: Data	250	—	100	—	ns	
STOP setup time	TSU: STO	4700	—	600	—	ns	
Output decision time from a clock	TAA	—	3500	100	900	ns	
Bus free time	TBUF	4700	—	1300	—	ns	
Rising time of Min VIH, VIL	TOF	—	250	20	250	ns	CB ≤ 100pF
Spike oppression	TSP	—	50	—	50	ns	
A write-in cycle time	TWR	—	10	—	10	ms	Byte and page mode
The number of times of data rewriting	—	1M	—	1M	—	cycles	VCC=5.0V Ta=25°C,

(4) Device Addressing

Device Code				Slave Address			R/W
				A2	A1	A0	
1	0	1	0	0	0	0	R/W

6. INTERFACE TIMING

6.1 INPUT SIGNAL TIMING SPECIFICATIONS

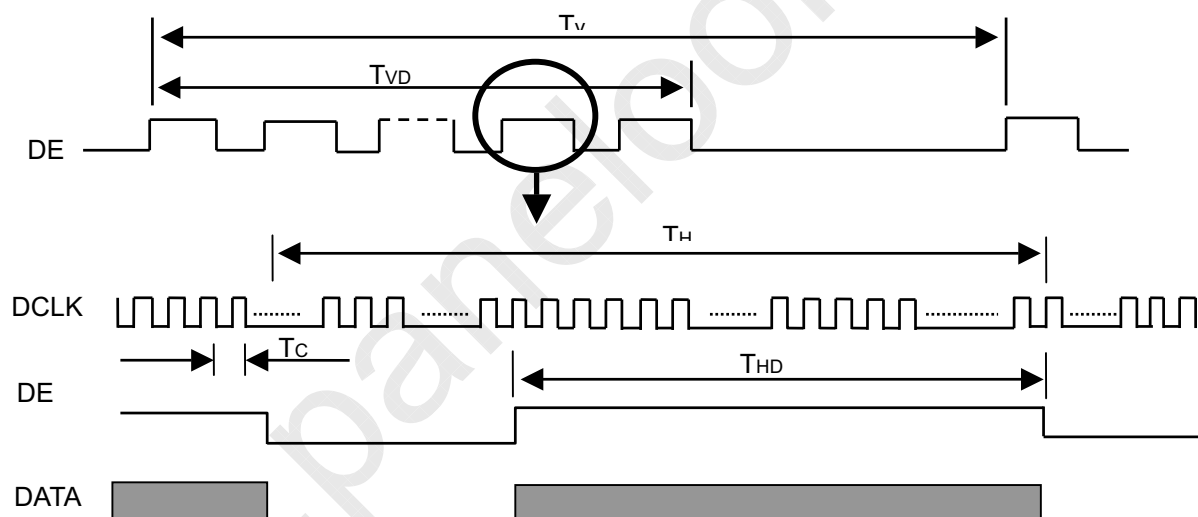
The input signal timing specifications are shown as the following table and timing diagram.

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
DCLK	Frequency	1/Tc	47.1	48.1	49.1	MHz	-
DE	Vertical Total Time	TV	905	912	950	TH	-
	Vertical Active Display Period	TVD	900	900	900	TH	-
	Vertical Active Blanking Period	TVB	TV-TVD	12	TV-TVD	TH	
	Horizontal Total Time	TH	832	880	1000	Tc	2
	Horizontal Active Display Period	THD	720	720	720	Tc	2
	Horizontal Active Blanking Period	THB	TH-THD	160	TH-THD	Tc	2

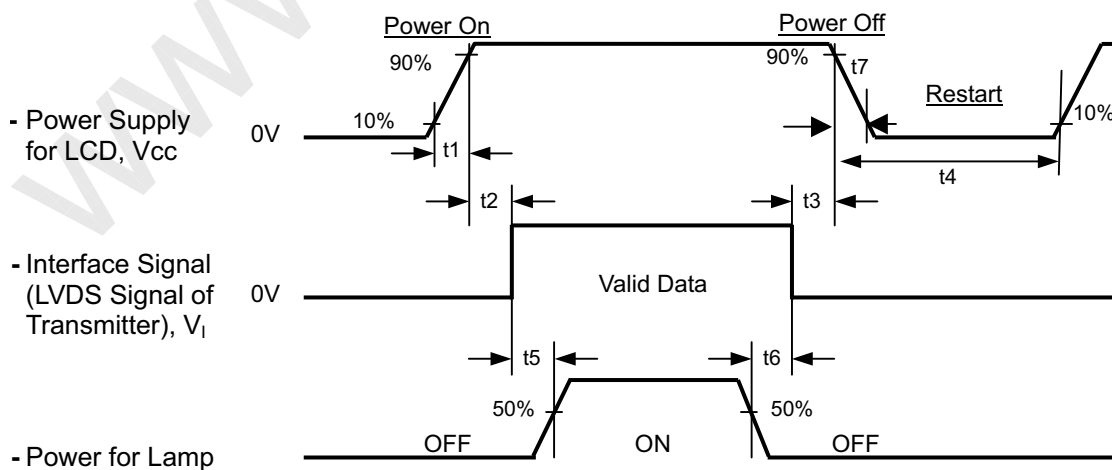
Note (1) Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

(2) 2 channels LVDS input

INPUT SIGNAL TIMING DIAGRAM



6.2 POWER ON/OFF SEQUENCE



Timing Specifications:

$$0 \leq t_1 \leq 20 \text{ ms}$$

$$0 < t_2 \leq 50 \text{ ms}$$

$$0 < t_3 \leq 50 \text{ ms}$$

$$t_4 \geq 200 \text{ ms}$$

$$t_5 \geq 100 \text{ ms}$$

$$t_6 \geq 0 \text{ ms}$$

$$0 \leq t_7 \leq 50 \text{ ms}$$

Note (1) Please avoid floating state of interface signal at invalid period.

Note (2) When the interface signal is invalid, be sure to pull down the power supply of LCD Vcc to 0 V.

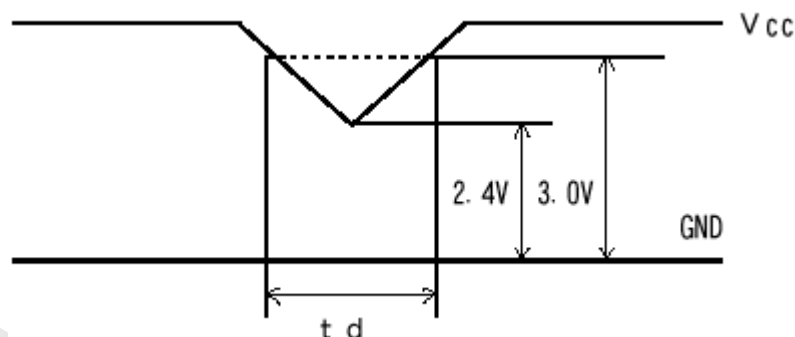
Note (3) The Backlight inverter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight inverter power must be turned off before the power supply for the logic and the interface signal is invalid.

Note (4) Sometimes some slight noise shows when LCD is turned off (even backlight is already off). To avoid this phenomenon, we suggest that the Vcc falling time is better to follow

$$t_7 \geq 5 \text{ msec}$$

Note (5) To avoid in-rush current is too large when power on. CMO suggest t1 should be larger than 470us when power on.

6.3 MOMENTARY VOLTAGE DROPS



(1) When $2.4\text{V} \leq V_{cc} < 3.0\text{V}$ and $t_d \leq 10\text{ms}$, the unit must work normally when VCC return to 3.0V.

(2) When $V_{cc} < 2.4\text{V}$, momentary voltage shall conform to the input voltage sequence.

7. OPTICAL CHARACTERISTICS

7.1 TEST CONDITIONS

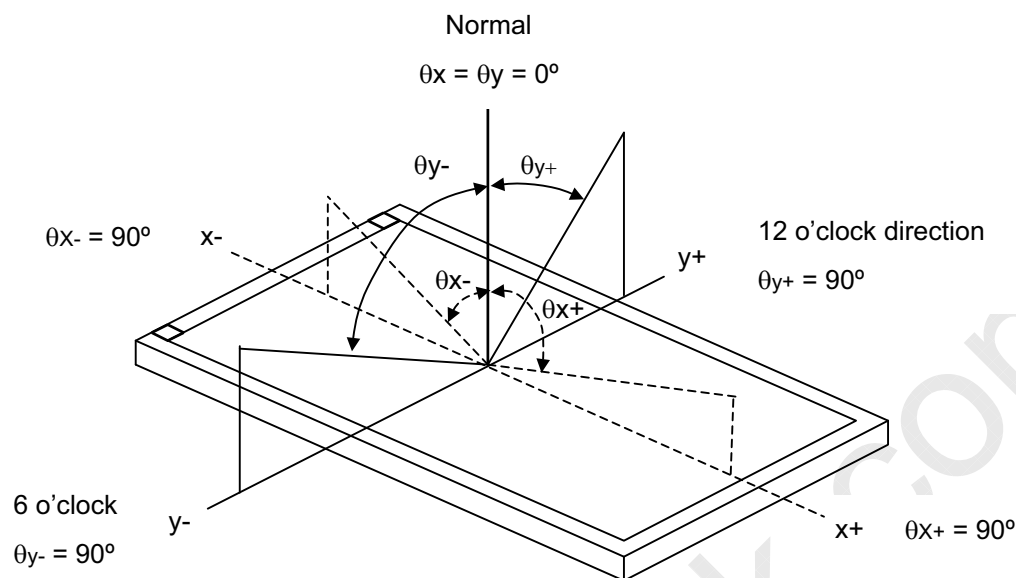
Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	V _{CC}	3.3	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
Inverter Current	I _L	6.0	mA
Inverter Driving Frequency	F _L	61	KHz
Inverter	(Sumida-H05-4915)		

The relative measurement methods of optical characteristics are shown in 7.2. The following items should be measured under the test conditions described in 7.1 and stable environment shown in Note (8).

7.2 OPTICAL SPECIFICATIONS

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Color Chromaticity	Red	R _x	$\theta_x=0^\circ, \theta_Y=0^\circ$ Viewing Normal Angle	TYP -0.03	0.643	TYP +0.03	—	(8)
		R _y			0.349			
	Green	G _x			0.283			
		G _y			0.600			
	Blue	B _x			0.142			
		B _y			0.074			
	White	W _x			0.313			
		W _y			0.329			
	Color Gamut	C.G%		—	72	—	%	(7), (8)
Center Luminance of White		L _{CEN}	340	400	—	cd/m ²	(4), (8)	
Contrast Ratio		CR	450	600	—	—	(2), (8)	
Response Time		T _R	—	5	10	ms	(3)	
		T _F	—	11	16	ms		
Cross Talk		CT	—	—	4.0	%	(5), (8)	
White Variation of A and B Domain		δW	70	—	—	%	(6)	
Viewing Angle	Horizontal	θ _x +	CR≥10	60	70	—	Deg.	(1)
		θ _x -		60	70	—		
	Vertical	θ _y +		50	60	—		
		θ _y -		50	60	—		

Note (1) Definition of Viewing Angle (θ_x , θ_y):



Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = L_{63} / L_0$$

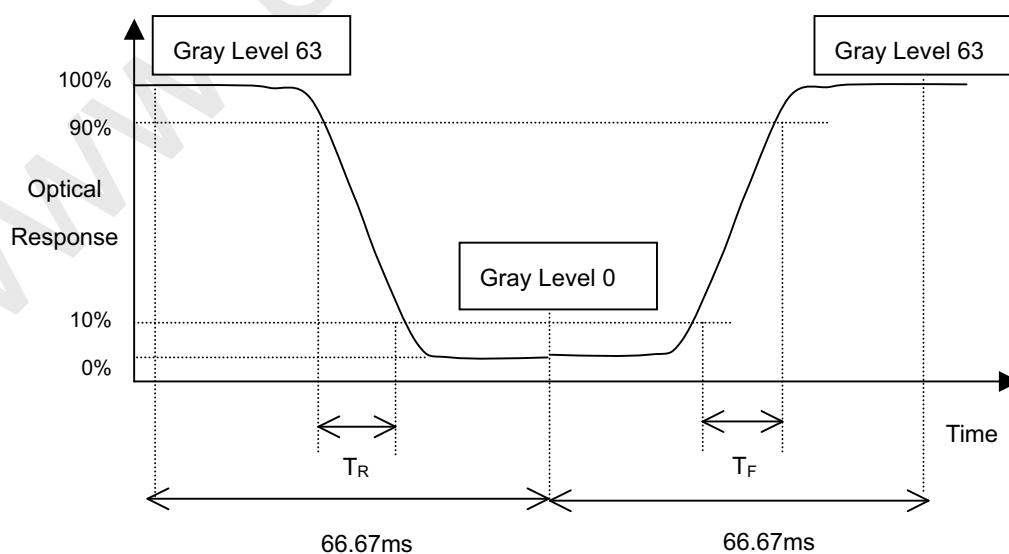
L63: Luminance of gray level 63

L 0: Luminance of gray level 0

$$\text{CR} = \text{CR} (1)$$

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (6).

Note (3) Definition of Response Time (T_R , T_F) and measurement method:



Note (4) Definition of Center Luminance of White (L_{CEN}):



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Measure the luminance of gray level 63 at center point

$$L_{CEN} = L(1)$$

L(x) is corresponding to the luminance of the point X at Figure in Note (6)

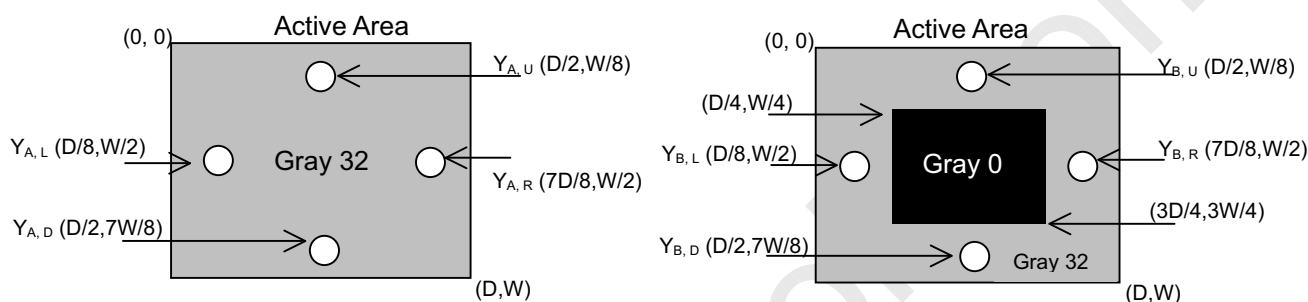
Note (5) Definition of Cross Talk (CT):

$$CT = |Y_B - Y_A| / Y_A \times 100 (\%)$$

Where:

Y_A = Luminance of measured location without gray level 0 pattern (cd/m^2)

Y_B = Luminance of measured location with gray level 0 pattern (cd/m^2)



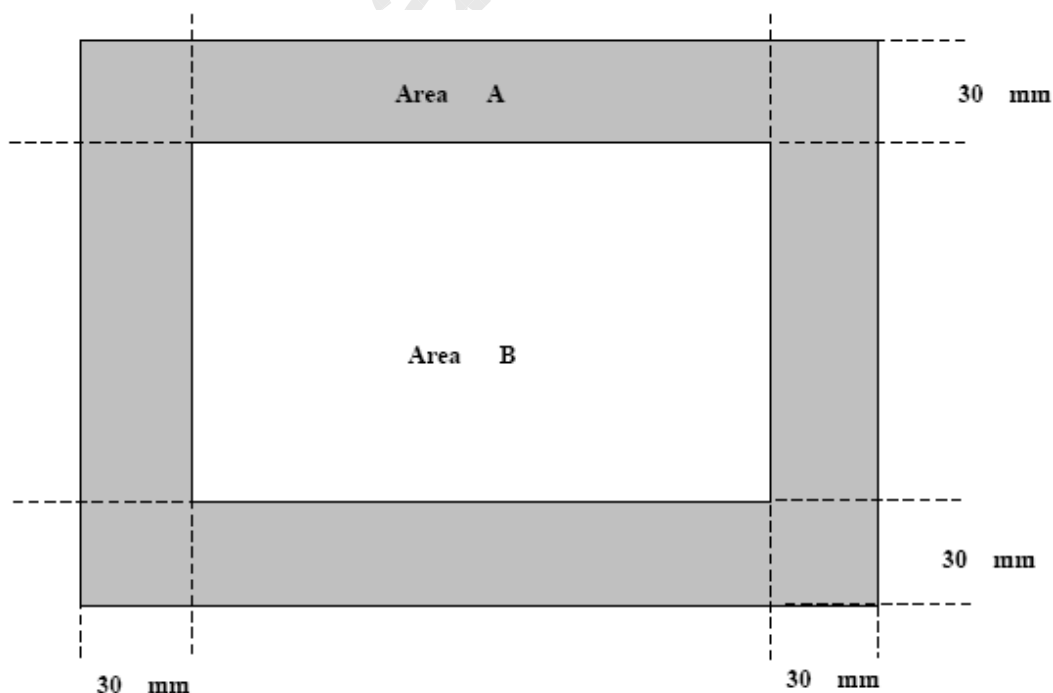
Note (6) Definition of White Variation (δW):

Measure the luminance of gray level 63 at any point of range A on active display area

$$\delta W_A = \text{Minimum } [L(\text{Any point of area A})] / \text{Maximum } [L(\text{Any point of area A})] \times 100 \%$$

Measure the luminance of gray level 63 at any point of range B on active display area

$$\delta W_B = \text{Minimum } [L(\text{Any point of area B})] / \text{Maximum } [L(\text{Any point of area B})] \times 100 \%$$



Note (7) Definition of color gamut (C.G%):

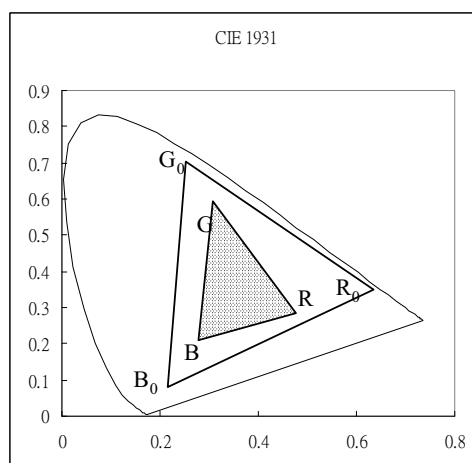
$$C.G\% = \Delta R G B / \Delta R_0 G_0 B_0 \cdot 100\%$$

R_0, G_0, B_0 : color coordinates of red, green, and blue defined by NTSC, respectively.

R, G, B : color coordinates of module on 63 gray levels of red, green, and blue, respectively.

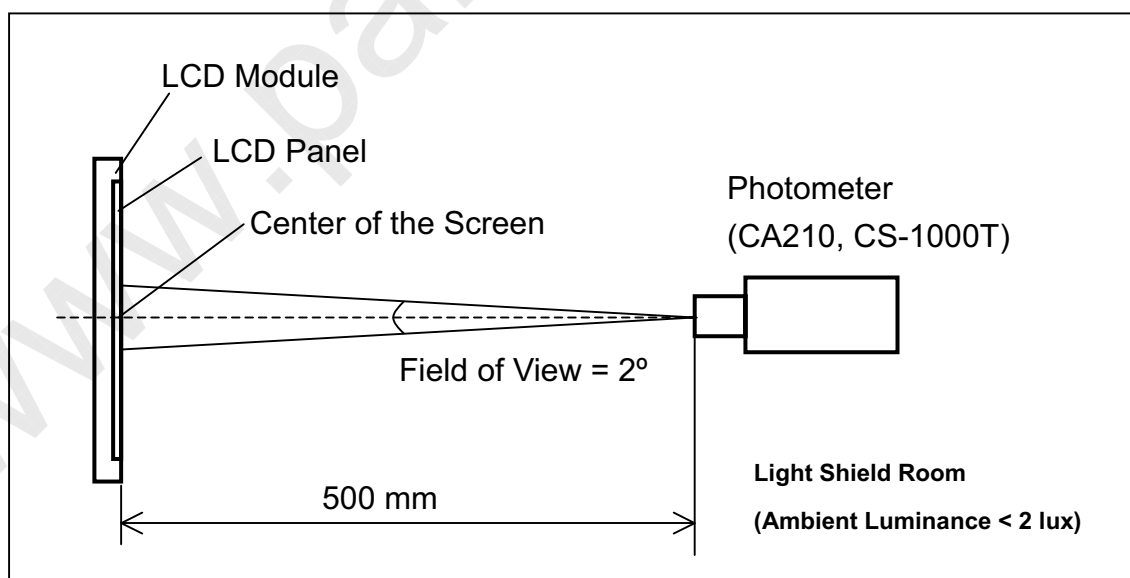
$\Delta R_0 G_0 B_0$: area of triangle defined by R_0, G_0, B_0

$\Delta R G B$: area of triangle defined by R, G, B



Note (8) Measurement Setup:

The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.



8. PRECAUTIONS

8.1 ASSEMBLY AND HANDLING PRECAUTIONS

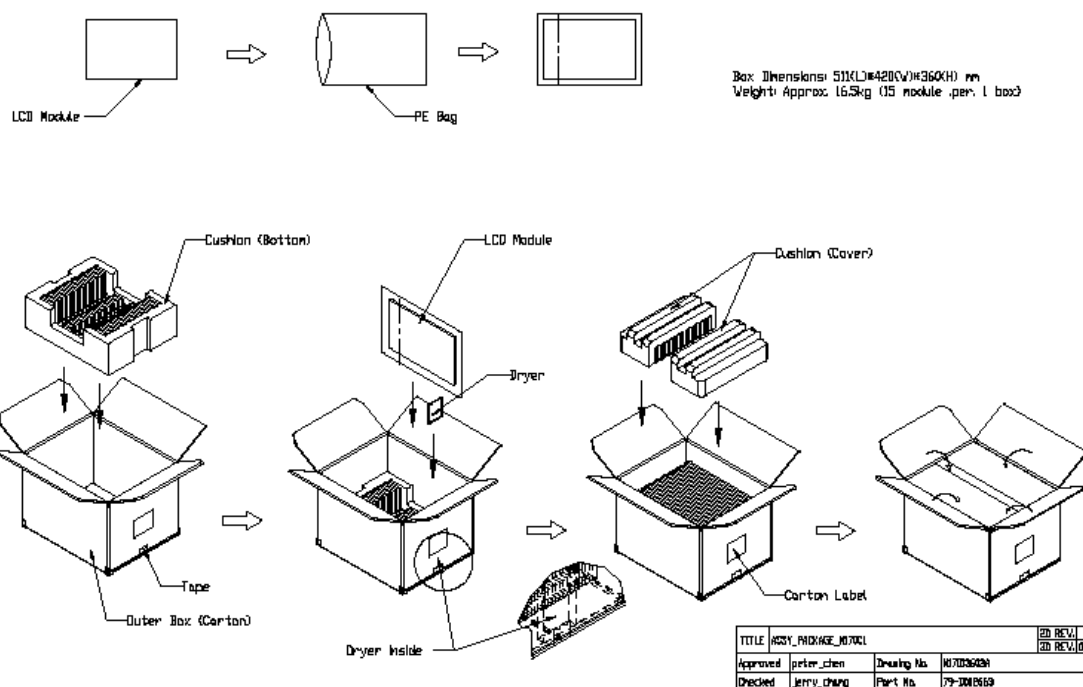
- (1) Do not apply rough force such as bending or twisting to the module during assembly.
- (2) To assemble or install module into user's system can be only in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
- (3) It's not permitted to have pressure or impulse on the module because the LCD panel and Backlight will be damaged.
- (4) Always follow the correct power sequence when LCD module is connecting and operating. This can prevent damage to the CMOS LSI chips during latch-up.
- (5) Do not pull the I/F connector in or out while the module is operating.
- (6) Do not disassemble the module.
- (7) Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.
- (8) It is dangerous that moisture come into or contacted the LCD module, because moisture may damage LCD module when it is operating.
- (9) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.
- (10) When ambient temperature is lower than 10°C may reduce the display quality. For example, the response time will become slowly, and the starting voltage of CCFL will be higher than room temperature.

8.2 SAFETY PRECAUTIONS

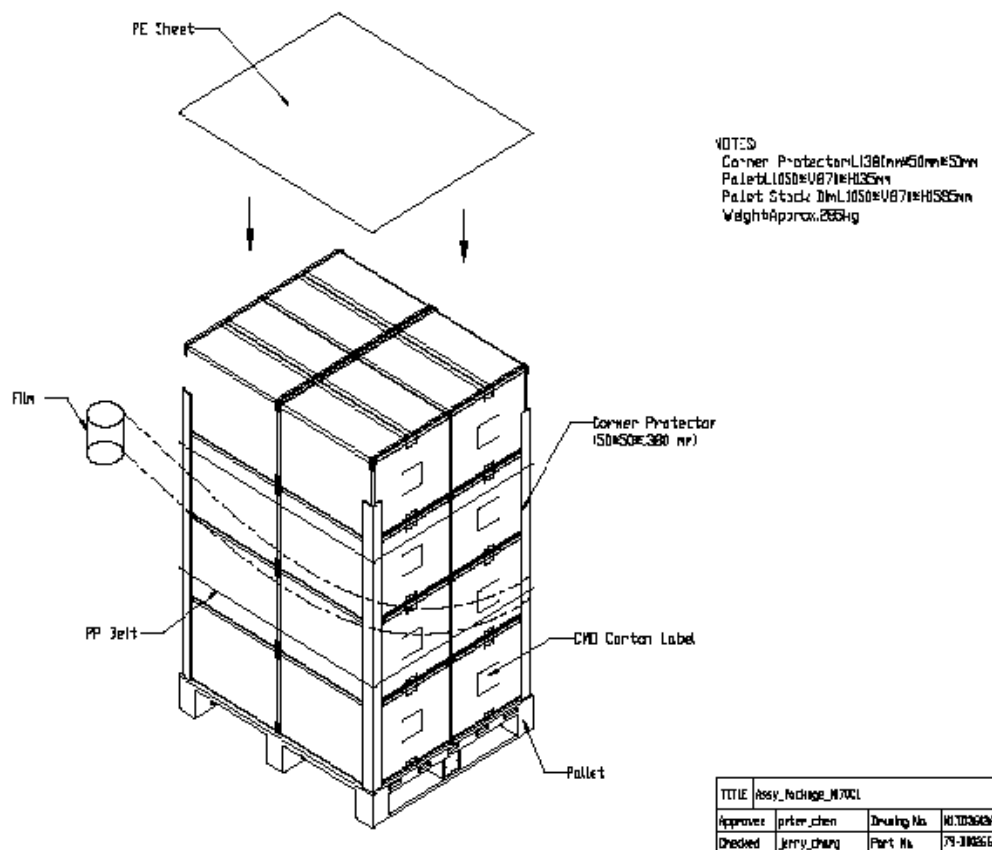
- (1) The startup voltage of Backlight is approximately 1000 Volts. It may cause electrical shock while assembling with inverter. Do not disassemble the module or insert anything into the Backlight unit.
- (2) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
- (3) After the module's end of life, it is not harmful in case of normal operation and storage.

9. PACKING

9.1 CARTON



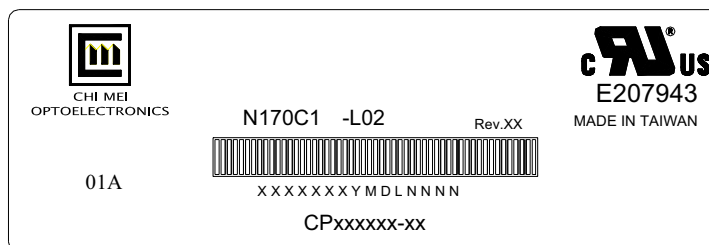
9.2 PALLET



10. DEFINITION OF LABELS

10.1 CMO MODULE LABEL

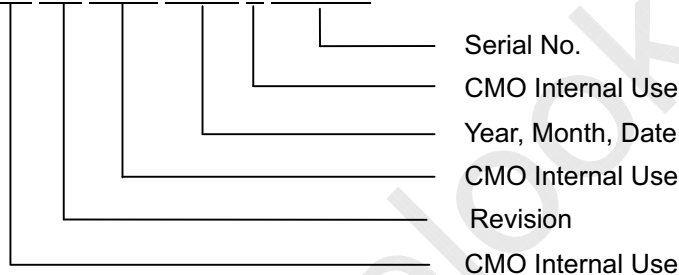
The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.



(a) Model Name: N170C1 - L02

(b) Revision: Rev. XX, for example: A1, ..., C1, C2 ...etc.

(c) Serial ID: XXXXXX YMDLNNNN



(d) Customer Internal Product Code : CPxxxxxx-xx

(e) Customer Internal Revision : XXX, for example: 01A, 02A ...etc

Serial ID includes the information as below:

(a) Manufactured Date: Year: 1~9, for 2001~2009

Month: 1~9, A~C, for Jan. ~ Dec.

Day: 1~9, A~Y, for 1st to 31st, exclude I, O and U

(b) Revision Code: cover all the change

(c) Serial No.: Manufacturing sequence of product



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Model No.: N170C1 - L02

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10.2 CARTON LABEL

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PO.NO. _____

Part ID. _____

Model Name _____

Carton ID. _____ Quantities _____



